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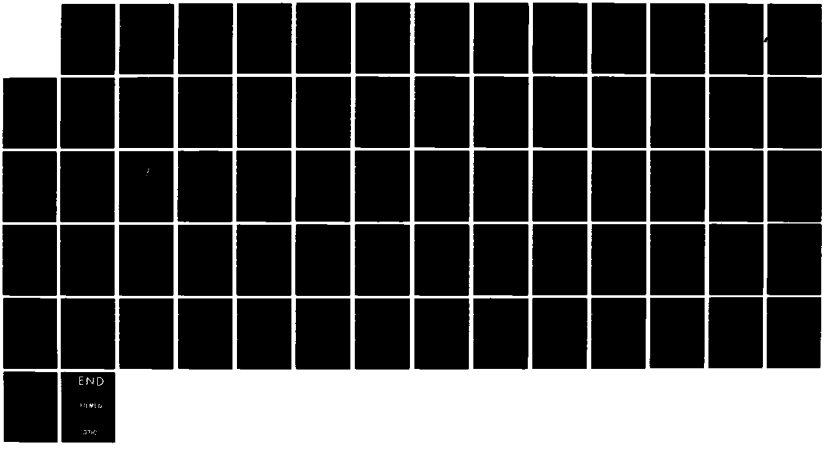

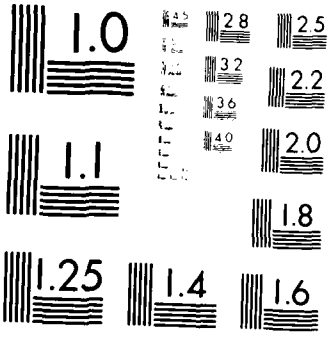

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# CENTRAL PROBLEMS IN THE MANAGEMENT OF INNOVATION

by

Andrew H. Van de Ven

THE STRATEGIC MANAGEMENT RESEARCH CENTER







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Andrew Van de Ven is 3M Professor of Human Systems Management in the School of Management, and director of the Strategic Management Research Center at the University of Minnesota. The author wishes to gratefully recognize the stimulation of ideas for this paper from faculty and student colleagues involved ir the Minnesota Innovation Research Program. This research program is supported in part by a major grant from the Organizational Effectiveness Research Programs, Office of Naval Research (Code 4420E), under Contract No. N00014-84-K-0016. Additional research support is being provided by 3M, Honeywell, Control Data, Dayton-Hudson, First Bank Systems, Cenex, Dyco Petroleum, and Magnetic Controls Corporations.

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INNOVATION IS DEFINED AS THE DEVELOPMENT AND IMPLEMENTATION OF NEW IDEAS BY PEOPLE WHO OVER TIME ENGAGE IN TRANSACTIONS WITH OTHERS WITHIN AN INSTITUTIONAL ORDER. THIS SIMPLE AND SEEMINGLY INNOCUOUS DEFINITION HAS MAJOR IMPLICATIONS FOR MANAGING INNOVATION. THIS DEFINITION FOCUSES ON FOUR BASIC FACTORS (NEW IDEAS, PEOPLE, TRANSACTIONS AND INSTITUTIONAL CONTEXT). AN UNDERSTANDING OF HOW THESE FACTORS ARE RELATED LEAD TO FOUR BASIC PROBLEMS CONFRONTING MOST GENERAL MANAGERS: 1) A HUMAN PROBLEM OF MANAGING ATTENTION

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ABSTRACT (CONTINUED)

2) A PROCESS PROBLEM IN MANAGING NEW IDEAS INTO GOOD CURRENCY,
3) A STRUCTURAL PROBLEM OF MANAGING PART-WHOLE RELATIONSHIPS AND
4) A STRATEGIC PROBLEM OF INSTITUTIONAL LEADERSHIP. APPRECIATING THESE PROBLEMS AND THEIR CONSEQUENCES PROVIDES A FIRST STEP IN DEVELOPING A PRACTICAL THEORY ON THE MANAGEMENT OF INNOVATION.

# CENTRAL PROBLEMS IN THE MANAGEMENT OF INNOVATION

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Abstract

Innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order. This simple and seemingly innocuous definition has major implications for managing innovation. This definition focuses on four basic factors (new ideas, people, transactions, and institutional context). An understanding of how these factors are related lead to four basic problems confronting most general managers: (1) a human problem of managing attention, (2) a process problem in managing new ideas into good currency, (3) a structural problem of managing part-whole relationships, and (4) a strategic problem of institutional leadership. Appreciating these problems and their consequences provides a first step in developing a practical theory on the management of innovation.

# CENTRAL PROBLEMS IN THE MANAGEMENT OF INNOVATION

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## Introduction

Few truly strategic issues are characterized by as much agreement as the role of innovation and entrepreneurship for social and economic development. Among scholars, Schumpeter's (1942) emphasis on the importance of innovation for the business firm and society as a whole is seldom disputed. More recently, in the wake of a decline in American productivity and obsolescence of its infrastructure has come the fundamental claim that America is losing its innovativeness. Witness, for example, the common call for stimulating innovation in recent best-seller books by Ouchi (1981), Pascale and Athos (1981), Peters and Waterman (1982), Kanter (1983), and Lawrence and Dyer (1983). Never before has the need for understanding and managing innovation appeared to be so widespread.

Of all the issues surfaced in our meetings with over 30 chief executive officers of public and private firms during the past few years, the management of innovation was reported as their most central concern in managing their enterprises in the 1980's (Van de Ven, 1982). This concern is reflected in a variety of questions the CEOs often raised.

1. How can a large organization develop and maintain a culture of innovation and entrepreneurship?
2. What are the critical factors in successfully launching new organizations, joint ventures with other firms, or innovative projects within large organizations over time?

3. How does one achieve balance between inexorable pressures for specialization and proliferation of tasks and escalating costs of achieving coordination, cooperation, and resolving conflicts?

Given the scope of these questions raised by CEOs, it is surprising to find that research and scholarship on organizational innovation has been so narrowly defined on the one hand, and so technically oriented on the other. Most of it has focused on only one kind of organizational mode for innovation -- such as internal organizational innovation (Normann, 1979), or new business startups (e.g., Cooper, 1979) -- or one stage of the innovation process -- such as the diffusion stage (Rogers, 1981) -- or one type of innovation -- such as technological innovation (Utterback, 1974). While such research has provided many insights into specific aspects of innovation, the diverse problems confronting general managers in managing innovation have been largely overlooked.

In most organizations, the general manager is responsible for managing across many different functions and interest groups both inside and outside of the organization. In small organizations or new business ventures, the general manager is the entrepreneur who tends to be directly involved in all segments of the business. As the business grows the job becomes more complicated because while the general manager continues to be responsible for all business segments, he or she is removed from direct and concrete tasks and must work through others to accomplish a mission. Thus, unlike managers who are responsible for a given function (e.g., finance, marketing, human resources, production, or R&D), the general manager's job is both more complex because it must integrate these functions, and more abstract because it is often several levels removed from the direct performance of instrumental tasks.

A central role of general and top managers is the management of innovation. However, it is clear that in this role the general manager must deal with a set of problems that are different from and less well understood than functional managers. What is needed is a perspective on innovation that focuses on the complex set of issues, processes, and temporal dimensions confronting general managers in managing innovation. The purpose of this paper is to present a perspective on the management of innovation that addresses key problems confronting general managers. Appreciating these problems and their consequences provides a first step in developing a practical theory on the management of innovation.

This general management perspective defines the process of innovation as the development and implementation of new ideas by people who engage in transactions with others over time within an institutional context. This definition is sufficiently general to apply to a wide variety of technical, product, process, and administrative kinds of innovations. From a managerial viewpoint, to understand the process of innovation is to understand the factors that facilitate and inhibit the development of innovation events over time. As our definition of innovation suggests, these factors include ideas, people, transactions, and context over time. Associated with each of these factors are basic problems or challenges that need to be addressed in a practical theory on the management of innovation.

First, there is the human problem of managing attention because people and their organizations are mostly designed to focus on, harvest, and protect existing practices rather than pay attention to developing new ideas. The more successful an organization is the more difficult it is to trigger peoples' action thresholds to pay attention to new ideas,

needs, and opportunities.

Second, the process problem is managing ideas into good currency so that innovative ideas are implemented and institutionalized. While the invention or conception of innovative ideas may be an individual activity, innovation (developing and implementing new ideas) is a collective achievement of pushing and riding those ideas into good currency. The social and political dynamics of innovation become paramount as one addresses the energy and commitment that are needed among coalitions of interest groups to develop an innovation.

Third, there is the structural problem of managing part-whole relationships, which emerges from the proliferation of ideas, people and transactions as an innovation develops over time. A common characteristic of the innovation process is that multiple functions, resources, and disciplines are needed to transform an innovative idea into a concrete reality -- so much so that individuals involved in individual transactions lose sight of the whole innovation effort. How does one put the whole into the parts?

Finally, the context of an innovation points to the strategic problem of institutional leadership. Innovations not only adapt to existing organizational and industrial arrangments, but they also transform the structure and practices of these environments. The strategic problem is one of creating an infrastructure that is conducive to innovation.

## Innovative Ideas

An Innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a

unique approach which is perceived as new by the individuals involved (Zaltman, Duncan, and Holbek, 1973; Rogers 1982). As long as the idea is perceived as new to the people involved, it is an "innovation," even though it may appear to others to be an "imitation" of something that exists elsewhere.

Included in this definition are both technical innovations (new technologies, products, and services) and administrative innovations (new procedures, policies, and organizational forms). Because we subscribe to a systems view, technical and administrative innovations are expected to be closely interrelated and co-produced. Daft and Becker (1979) and others have emphasized keeping technical and administrative innovations distinct. We believe that making such a distinction often results in a fragmented classification of the innovation process. In contrast, we argue that associated with most any new technology, product, or service are new administrative policies and organizational arrangements, and vice versa. Specifically, we propose that:

Prop. 1 Variations in technical innovation will correspond with variations in administrative innovation, just as reorientations of administrative arrangements will be associated with reorientations of products, services, or technologies -- and vice versa.

Normann (1979) has defined "variations" as modifications or adjustments in existing technologies or processes, while "reorientations" represent major shifts to totally new technologies and processes not previously existing in the organization or group. Learning to understand the close connection between technical and administrative dimensions of innovations is a key part of understanding the management of innovation.

Kimberly (1981) rightly points out that a positive bias pervades the study of innovation. Innovation is often viewed as a good thing because the new idea must be useful -- profitable, constructive, or solve a problem. New ideas that are not perceived as useful are not normally called innovations; they are usually called mistakes. Objectively, of course, the usefulness of an idea can only be determined after the innovation process is completed and implemented. Moreover, while many new ideas are proposed in organizations, only a very few receive serious consideration and developmental effort (Wilson, 1966; Maitland, 1982). Since it is not possible to determine at the outset which new ideas are "innovations" or "mistakes," and since we assume that people prefer to invest their energies and careers on the former and not the latter, there is a need to explain (1) how and why certain innovative ideas gain good currency (i.e, are implemented), and (2) how and why people pay attention to only certain new ideas and ignore the rest. These two questions direct our focus to problems of managing ideas into good currency and the management of attention.

The Management of Ideas into Good Currency.

It is often said that an innovative idea without a champion gets no where. People develop, carry, react to, and modify ideas. People apply different skills, energy levels and frames of reference (interpretive schemas) to ideas as a result of their backgrounds, experiences, and activities that occupy their attention.

Prop. 2 People are connected to ideas over time through a social-political process of pushing and riding their ideas into good currency, much like Donald Schon (1971) describes for the emergence of public policies.

Figure 1 illustrates the process.

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Insert Figure 1 about here

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Schon states that what characteristically precipitates change in public policy is a disruptive event which threatens the social system and sets up a demand for new ideas that will explain, diagnose, or remedy the crisis. Invention is an act of appreciation, which is a complex perceptual process that melds together judgments of reality and judgments of value. A new appreciation is made as an anomoly, problem, or opportunity is recognized. Once a problem is appreciated, ideas gestating in peripheral areas begin to surface to the mainstream as a result of the efforts of people who supply the energy necessary to raise the ideas over the threshold of public consciousness. As these ideas surface networks of individuals, stakeholders and the communication media or gapevine gravitate to and galvanize around the new ideas. They, in turn, exert their own influence on the ideas by further developing and articulating the ideas and providing them with a catchy slogan that provides emotional meaning and energy to the idea.

However, Schon indicates that at this articulation stage innovative ideas are not potent to change policy unless they become an issue for political debate and unless they are used to gain influence and resources. The debate turns not only on the merits of the ideas proposed to address the problems, but also on who is using the ideas as vehicles to gain power. When individuals or stakeholders push or ride ideas, they also seek to establish their own dominance. As the ideas are taken up by people who are or have become powerful, the ideas gain legitimacy and power to change institutions. After this, the ideas that win out are

Most transactions do not follow a simple linear progression through the stages of negotiations, agreements, and execution (as outlined above). The more novel and complex the innovative idea, the more often trial-and-error cycles of renegotiation, recommitment, and readministration of transactions will occur. Moreover, the selection of certain kinds of transactions is always conditioned by the range of past experiences and current situations to which individuals have been exposed. Therefore, people have a conservative bias to enter into transactions with parties they know, trust, and with whom they have had successful experiences. As a consequence and as observed by Terryberry (1968) with interorganizational relationships, what may start as an interim solution to an immediate problem often proliferates over time into a web of complex and interdependent transactions among the parties involved.

There is an important connection between transactions and organizations. Transactions are the micro elements of macro organizational arrangements. Just as the development of an innovation might be viewed as a bundle of proliferating transactions over time, so also, is there proliferation of functions and roles to manage this complex and interdependent bundle of transactions in the institution that houses the innovation.

The prevailing approach for handling this complexity and interdependence is to divide the labor among specialists who are best qualified to perform unique tasks and then to integrate the specialized parts to recreate the whole. The objective, of course, is to develop synergy in managing complexity and interdependence with an organizational design where the whole is greater than the sum of its

(1951), the orginator of the concept, argued that transactions are the fundamental building blocks of economic and social relationships. He emphasized that transactions are dynamic and go through three temporal stages: negotiations, agreements, and administration.

The negotiations stage highlights the strategies and choice behavior of parties as they select, approach, and avoid alternative parties and as they persuade, argue, and haggle terms of becoming involved in an innovative undertaking.

In the agreement (or commitment) stage the "wills of the parties meet" by agreeing (whether formal for informal) to the terms of the relationship and the working rules or procedures of action. It is here where structural arrangements are set to organize an innovation -- be they the establishment of a collegial relationship among peers, a hierarchical relationship between supervisors and subordinates in the development of the innovation, commitments to secure funding and allocate resources to the innovation, or market transactions to contract, co-venture, license, or otherwise undertake various activities needed develop an innovation over time.

Finally, in the administrative stage the rules and procedures are carried into effect. It is in this stage where misunderstandings, conflicts, and changing expectations of a relationship often occur -- resulting in renegotiation, mutual adaptation, litigation, or termination of the relationship. Those transactions that endure over time become institutionalized -- meaning that the parties involved unconsciously begin to take the terms of the agreement for granted. Only when significant precedents occur do the parties involved reflect and reconstruct in memory the initial, but now hazy, terms of the transaction they initially negotiated and agreed upon.

systematically addressed in a practical theory of the management of innovation.

## The Management of Part-Whole Relationships

Prop. 4 Proliferation of ideas, people, and transactions over time is a pervasive but little understood characteristic of the innovation process, and with it come complexity and interdependence -- and the basic structural problem of managing part-whole relations.

The proliferation of ideas is frequently observed in a single individual who works to develop an innovation from concept to reality. Over time the individual develops a mosaic of perspectives, revisions, extensions, and applications of the initial innovative idea -- and they accumulate into a complex set of interdependent options. However, as the discussion of managing ideas into good currency implies, innovation is not an individual activity -- it is a collective achievement. Therefore, over time there is also a proliferation of people (with diverse skills, resources, and interests) who become directly and indirectly involved in the innovation process. When a single innovative idea is expressed to others at any given time, it proliferates into multiple ideas because people have diverse frames of reference, or interpretive schemas, that filter their perceptions. These differing perceptions and frames of reference are amplified by the proliferation of transactions among people that occur as the innovation unfolds. Indeed, management of the innovation process can be viewed as managing increasing bundles of transactions over time.

Transactions are "deals" or exchanges which tie people together within an institutional framework (which is context). John R. Commons

must be unlearned and single loop learning must be replaced by double loop learning before significant change can occur. After all, the purpose of a control system is to detect and eliminate change, and tactics are means for ensuring attention on existing strategies.

Double loop learning manages attention by unlearning Starbuck's action generators. Evaluation criteria are questioned, strategies are criticized, and top management competence is debated. While this could lead to change, it could also lead to low trust, defensive behavior, undiscussibles, and to bypass tactics. Thus, the management of attention must be concerned not only with triggering the action thresholds of organizational participants, but also of channeling that action toward constructive ends.

Richard Normann (1985) suggests ways of containing the possible negative consequences of double loop learning, by focusing on organizational constitution, culture, and philosophy. Constitutions provide a framework for structural change, limiting the degree of change to tolerable levels. Culture, by storing and communicating past learning, also provides a tempering force. Finally, philosophy, which includes a mission statement, provides yet another anchor on change. Importantly, Normann states that philosophy is a double-edged sword. It constrains inappropriate change by holding some beliefs as unquestionable, yet if too tightly held, will not allow appropriate change.

While these suggestions appear to go in the right direction, it is clear that they are only partially developed to cope with the significant problem of organizational inertia and limitations of human beings. The management of attention remains as a major problem to be

conditions does stress have favorable versus unfavorable effects on the innovation process? Janis outlines five basic patterns of coping with stress, and states that only the vigilance pattern generally leads to decisions that meet the main criteria for sound decision making. Janis proposes that vigilance tends to occur under conditions of moderate stress and when there may be sufficient time to search and deliberate before a decision. Under conditions of high stress and immediate deadlines the decision process will resemble the characteristics of crisis decisions summarized above resulting in errors arising from stereotyping, uncritical use of heuristics, and losses of mental efficiency from information overload.

Argyris and Schon (1982) focus on single loop, double loop, and deutero learning models for managing attention that may improve the innovation process. In single loop learning, no change in criteria of effective performance takes place. Single loop learning represents conventional monitoring activity, with actions taken based on the findings of the monitoring system. Double loop learning involves a change in the criteria of evaluation. Past practices are called into question, new assumptions about the organization are raised, and significant changes in strategy are believed to be possible. Deutero learning is basically the ability to achieve repeated double loop learning -- organizational participants learn how to learn by watching themselves repeatedly using double loop learning.

Because it does not question the criteria of evaluation, single loop learning leads to the type of inertial behavior programs which Starbuck (1983) indicates must be unlearned before change can occur. Single loop learning is the basis of most organizational control systems and tactics. If this is correct, it would explain why behavior programs

Thus, for all the rational virtues that structures and systems provide to maintain existing organizational practices, these "action generators" make organizational participants inattentive to shifts in organizational environments and the need for innovation (Starbuck, 1983). The consequence, as James Brian Quinn pointed out at a recent conference, is that "while organizations may be built brick by brick, they assuredly destroy themselves drop by drop." It is surprising that we know so little about the management of attention. However, several useful prescriptions have been made.

At a recent conference on strategic decision making (Pennings, 1985), Paul Lawrence reported that in his consulting practice he usually focuses on what management is not paying attention to. Similarly based on his observations in consulting with large organizations, Richard Normann observed that well-managed companies are not only close to their customers, they search out and focus on their most demanding customers. Empirically, von Hippel (1977) has shown that ideas for most new product innovations come from customers. Being exposed face-to-face with demanding customers or consultants increases the likelihood that the action threshold of organizational participants will be triggered and will stimulate them to pay attention to changing environmental conditions or customer needs. In general, we would expect that direct personal confrontations with problem sources are needed to reach the threshold of concern and appreciation required to motivate people to act (Van de Ven, 1980b).

However, while face-to-face confrontations with problems may trigger action thresholds, they also create stress. One must therefore address the major problem that Janis (1985) examines: Under what

approach to problems in as little as three years. Groups minimize internal conflict and focus on issues that maximize consensus. "Group Think" is not only partly a product of these internal conformity pressures, but also of external conflict -- "out-group" conflict stimulates "in-group" cohesion (Coser, 1959). Consequently, it is exceedingly difficult for groups to entertain threatening information that is an inherent element of any truly innovative idea.

By focusing on the process of change, which the garbage can model largely ignores, Starbuck (1983) is able to more accurately describe logics in use in organizations. Where the garbage can model implies stalemate and inaction, Starbuck predicts programs which will generate action (but not change) even without decisions or problems. Organizations develop behavior programs to repeat the actions which led to earlier success -- but the programs do not necessarily address causal factors. Instead, the programs tend to be more like superstitious learning, recreating actions which may have little to do with previous success and nothing to do with future success.

Moreover, behavior programs are attention managers, focusing efforts in some areas and blinding people to other issues by influencing perceptions, values, and beliefs. The older, more bureaucratized, larger, and more successful organizations become, the more likely they are to have a large repertoire of automatic or semi-automatic behavior programs which discourage innovation while encouraging tinkering. For example, strategic planning <u>systems</u> often drive out strategic thinking as participants "go through the numbers" of completing yearly planning forms and review cycles. The implication is that age, size, formalization, and success carry with them the seeds of attention to routine, not innovation.

do not move into action to correct their situation, which over time may become deplorable. Opportunities for innovative ideas are not recognized, problems swell into metaproblems, and at the extreme, catastrophes are sometimes necessary to reach the action threshold (Van de Ven, 1980b).

These worsening conditions are sometimes monitored by various corporate planning and management information units and distributed to personnel in quantitative MIS reports of financial and performance trends. However, these impersonal statistical reports only increase the numbness of organizational participants and raise the false expectation that if someone is measuring the trends then someone must be doing something about them.

When situations have deteriorated to the point of actually triggering peoples' action thresholds, innovative ideas turn out to be crisis management ideas. As Janis (1982) describes, such decision processes are dominated by defense mechanisms of isolation, projection, stereotyping, displacement, and retrospective rationalizations to avoid negative evaluations. As a result, the substantive conclusions that emerge from such "innovative" ideas are likely to be "mistakes."

If one includes the group and organizational levels, the problems of inertia, conformity, and incompatible preferences need to be added to the the above physiological limitations of human beings in managing attention. As Janis (1982) has clearly shown, groups place strong conformity pressures on members, who collectively conform to one another without them knowing it. Indeed, the classic study by Pelz and Andrews (1966) found that a heterogeneous group of interdisciplinary scientists when working together daily became homogeneous in perspective and

It is generally believed that crises, dissatisfaction, tension, or significant external stress are the major preconditions for stimulating people to act. March and Simon (1958) set forth the most widely accepted model by arguing that dissatisfaction with existing conditions stimulates people to search for improved conditions, and they will search for only as long as a satisfactory result is found. A satisfactory result is a function of a person's aspiration level, which Lewin (1947) indicated is a product of all past successes and failures that people have experienced. If this model is correct (and most believe it is), then scholars and practitioners must wrestle with another basic problem.

This model assumes that when people reach a threshold of dissatisfaction with existing conditions, they will initiate action to resolve their dissatisfaction. However, individuals are amazingly adaptible to their environments -- often without recognizing that they are adapting over time. In this sense, individuals are much like frogs. Although we know of no empirical support for the frog story developed by Gregory Bateson, it goes as follows.

> When frogs are placed into a boiling pail of water, they jump out -- they don't want to boil to death.
>
> However, when frogs are placed into a cold pail of water, and the pail is placed on a stove with the heat turned very low, over time the frogs will boil to death.

Cognitive psychologists have found that individuals have widely varying and manipulable adaptation levels (Helson, 1948; 1964). When exposed over time to a set of stimuli that deteriorate very gradually, people do not percieve the gradual changes -- they unconsciously adapt to the worsening conditions. Their threshold to tolerate pain, discomfort, or dissatisfaction is not reached. As a consequence, they

It is well established empirically that individuals lack the capability and inclination to deal with complexity (Tversky and Kahneman, 1974; Johnson, 1983). Individuals have very short spans of attention -- the average individual can retain raw data in short-term memory for only a few seconds. Memory, it turns out, requires relying on "old friends," which Simon (1947) describes as a process of linking raw data with pre-existing schemas and world views that an individual has stored in long-term memory. Individuals are also very efficient processors of routine tasks. They do not concentrate on repetitive tasks, once they are mastered. Skills for performing repetitive tasks are repressed in subconscious memory, permitting individuals to pay attention to things other than performance of repetitive tasks (Johnson, 1983). Ironically as a result, what individuals think about the most is what they will do, but what they do the most is what they think about the least.

In complex decision situations, individuals create stereotypes as a defense mechanism to deal with complexity. For the average person, sterotyping is likely to begin when seven (plus or minus two) factors, steps, or individuals are involved in a decision -- this number being the information processing capacity of the average individual (Miller, 1956). As decision complexity increases beyond this point, people become more conservative and apply more subjective criteria which are futher and further removed from reality (Filley, House, and Kerr, 1976). Furthermore, since the correctness of outcomes to innovative ideas can rarely be judged, the perceived legitimacy of the decision <u>process</u> becomes the dominant evaluation criterion. Thus, as March (1981) and Janis (1982) point out, as decision complexity increases, solutions become increasingly error prone, means become more important than ends, and rationalization replaces rationality.

engages in trying to see the situation from the others' viewpoints" (Gilbert and Freeman, 1984: 4).

A third, and even more basic problem is the management of attention -- how do individuals become attached to and invest effort in the development of innovative ideas? Human beings and their organizations are mostly designed to focus on, harvest, and protect existing practices rather than to pave new directions. This is because people have basic physiological limitations of not being able to handle complexity, of unconsciously adapting to gradually changing conditions, of conforming to group and organizational norms, and of focusing on repetitive activities (Van de Ven and Hudson, 1984). One of the key questions in the management of innovation then becomes, how to trigger the action thresholds of individuals to appreciate and pay attention to new ideas, needs and opportunities.

## The Management of Attention

Much of the folklore and applied literature on the management of innovation has ignored the research by cognitive psychologists and social-psychologists about the limited capacity of human beings to handle complexity and pay attention. As a consequence, one often gets the impression that inventors or innovators have super-human creative heuristics or abilities to "walk on water" (Van de Ven and Hudson, 1985).

Prop. 3 A practical theory of innovation should begin with an appreciation of the physiological limitations of human beings to pay attention to nonroutine issues, and their corresponding inertial forces in organizational life.

as observed by Cohen, March and Olsen (1972), decision makers have the feeling they are always working on the same problems in somewhat different contexts, but mostly without results.

Except for its use in legislative bodies, the idea of formally managing the socio-political process of pushing and riding ideas into good currency is novel. However, as Huber (1984: 938) points out, the decision process is similar to project management and program planning situations. Thus, Huber proposes the adoption of proven project management and program planning technologies (e.g., PERT, CPM and PPM) for managing the production of ideas into good currency. For example, based upon a test of the Program Planning Model, Van de Ven (1980a; 1980b) concluded that the PPM avoids problems of decision flight and failing into a rut that are present in March and Olsen's (1976) garbage can model of anarchical decision making. This is accomplished by the PPM's three-way matching of phased tasks with different decision processes and with different participants over time in a program planning effort.

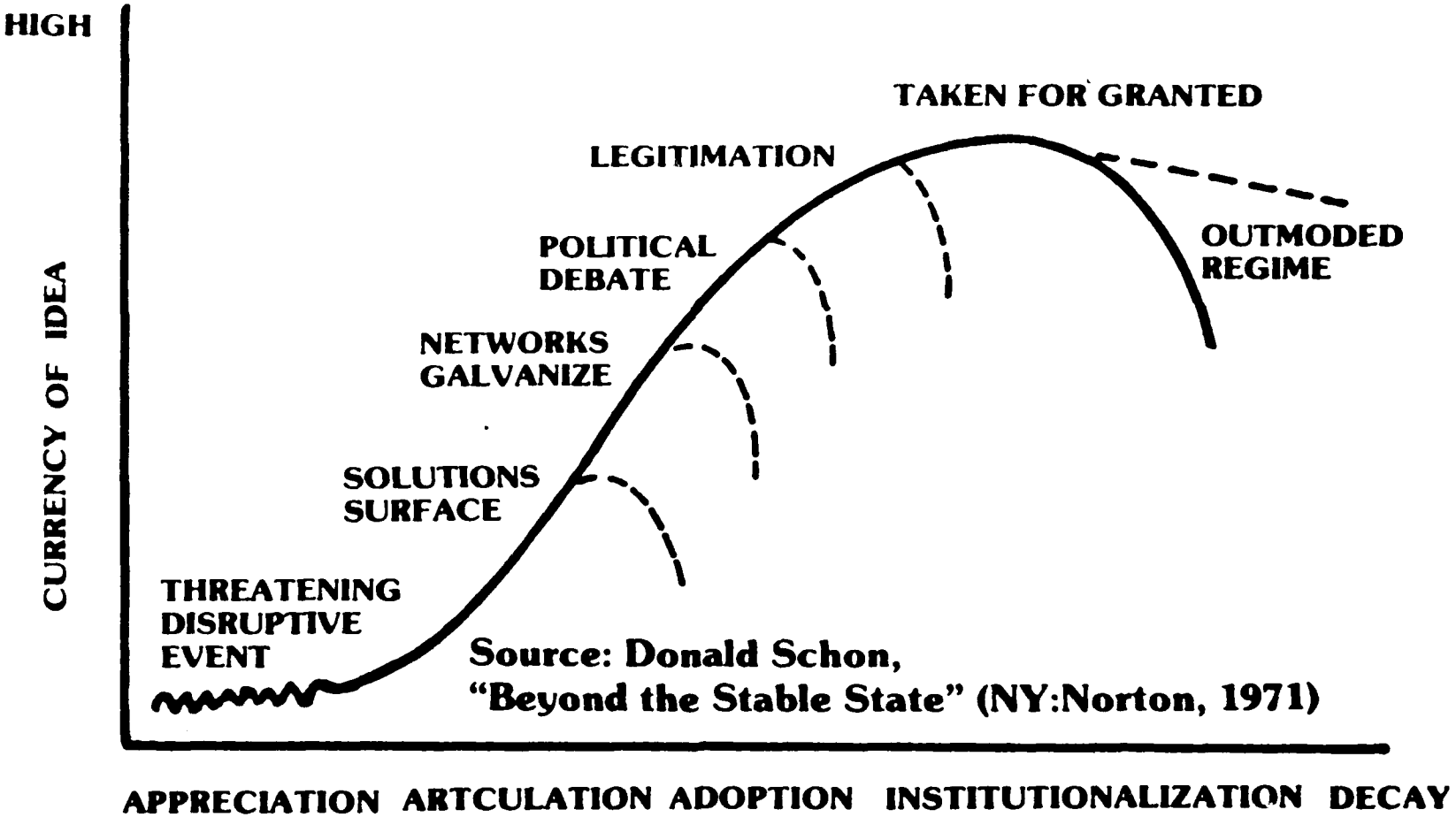
A second limitation of the process is that the inventory of ideas is seldom adequate for the situation. This may be because environmental scanning relevant to an issue does not uncover the values and partisan views held by all the relevant stakeholders. Gilbert and Freeman (1984) point out that with the general concept of environmental scanning, current models of strategic decision making gloss over the need to identify specific stakeholders to an issue and to examine their underlying values which provide reasons for their actions. Viewing the process from a game theoretic framework, they state that "effective strategy will be formulated and implemented if and only if each player successfully puts himself or herself in the place of other players and

implemented and become institutionalized -- they become part of the conceptual structure of the social system and appear, in retrospect, obvious. However, the idea remains institutionalized for only as long as it continues to address critical problems and as long as the regime remains in power.

Schon's description of the stages by which ideas come into good currency is instructive in its focus on the social-political dynamics in the innovation process over time. The description emphasizes the centrality of ideas as the rallying point around which collective action mobilizes -- organizational structures emerge and are modified by these ideas. Moreover, it is the central focus on ideas that provides the vehicle for otherwise isolated, disconnected, or competitive individuals and stakeholders to come together and contribute their unique frames of reference to the innovation process. Schon (1971:141) states that these stages characteristically describe the process features in the emergence of ideas into good currency, "regardless of their content or conditions from which they spring."

However, there are also some basic limitations to the proces that lead to inertia and premature abandonment of some ideas. First, there tends to be a short-term problem orientation in individuals and organizations, and a fascade of demonstrating progress. This has the effect of inducing premature abandonment of ideas because even if problems are not being solved, the appearance of progress requires moving on to the next batch of problems. Thus, "old questions are not answered -- they only go out of fashion" (Schon, 1971:142). Furthermore, given the inability to escape the interdependence of problems, old problems are relabeled as new problems. As a result, and

FIGURE 1. # MANAGING LIFE CYCLE OF IDEAS IN GOOD CURRENCY



parts. However, the whole often turns out to be less than or a meaningless sum of the parts because the parts do not add to, but subtract from one another (Hackman, 1984). This result has been obtained not only when summing the products of differentiated units within organizations, but also the benefits member firms derive from associating with special interest groups (Maitland, 1983; 1985). Research by Kanter (1983), Tushman and Romanelli (1983), and Peters and Waterman (1982) has shown that this "segmentalist" design logic is severely flawed for managing highly complex and interdependent activities. Perhaps the most significant structural problem in managing complex organizations today, and innovation in particular, is the management of part-whole relations.

For example, the comptroller's office detects an irregularity of spending by a subunit and thereby eliminates an innovative "skunkworks" group; a new product may have been designed and tested, but runs into problems when placed into production because R&D and engineering overlooked a design flaw; the development of a major system may be ready for production, but subcontractors of components may not be able to deliver on schedule or there may be material defects in vendors' parts. Typical attributions for these problems include: lack of communication or misunderstandings between scientific, engineering, manufacturing, marketing, vendors and customers on the nature or status of the innovation; unexpected delays and errors in certain developmental stages that complicate further errors and rework in subsequent stages; incompatible organizational funding, control, and reward policies; and ultimately significant cost over-runs and delayed introductions into the market.

Peters and Waterman (1982) dramatize this problem of part-whole

relationships with Figure 2, which illustrates that 223 reviews and approvals were necessary among 17 standing committees in order to develop an innovation from concept to market reality in an organization. Moreover, they state that

> The irony, and the tragedy, is that each of the 223 linkages taken by itself makes perfectly good sense. Well-meaning, rational people designed each link for a reason that made sense at the time.... The trouble is that the total picture as it inexorably emerged... captures action like a fly in a spider's web and drains the life out of it (Peters and Waterman, 1982: 18-19).

---

Insert Figure 2 about here

---

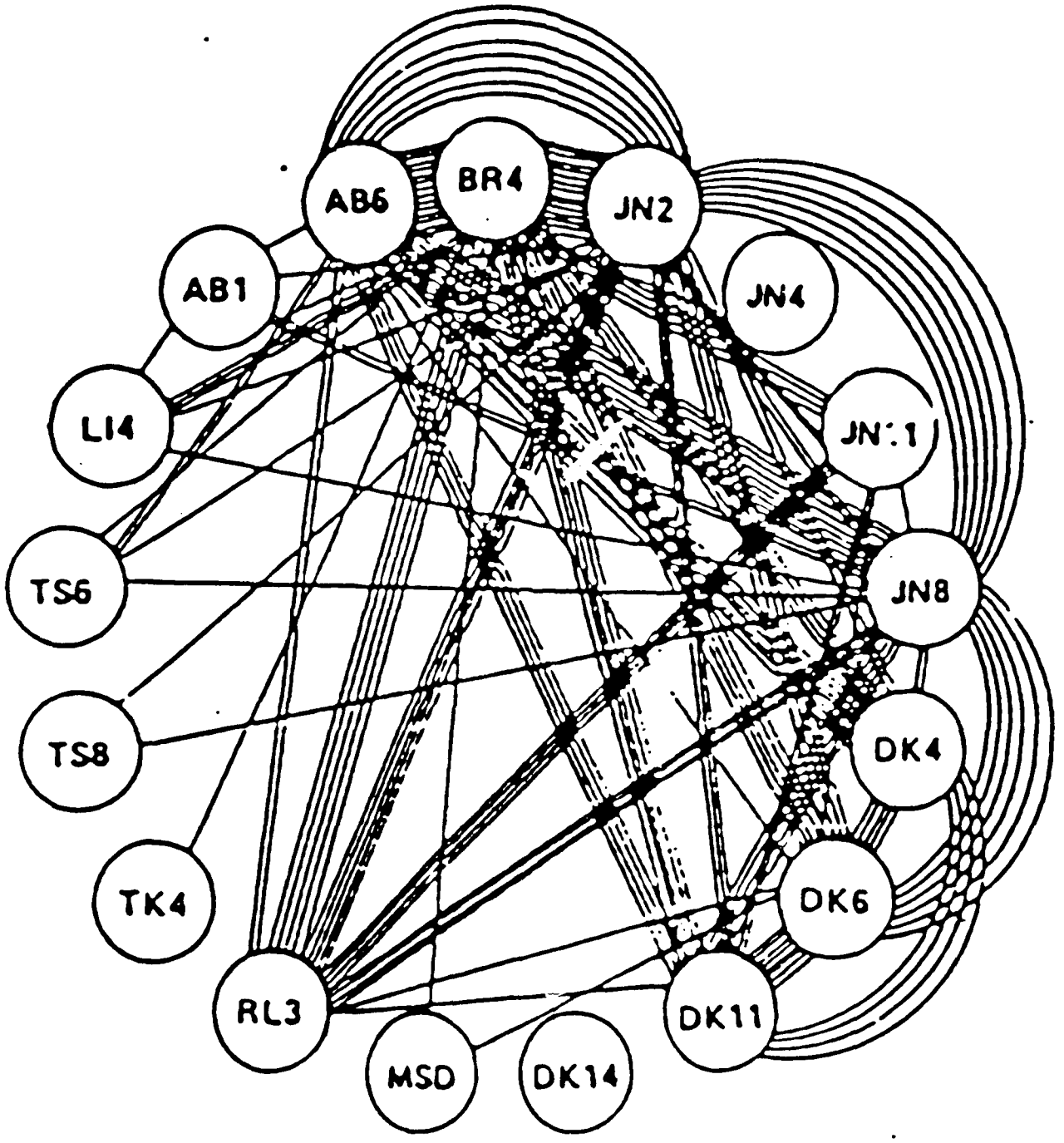
This example clearly illustrates a basic principle of contradictory part-whole relationships -- impeccable micro-logic often creates macro nonsense, and vice versa.

Is there a way to avoid having the whole be less than or a meaningless sum of its parts? Perhaps a way is needed to design the whole into the parts, as Gareth Morgan (1983a; 1983b; 1984) has been pursuing with the concept of a hologram. He reports the following.

> In a famous experiment, the American psychologist Karl Lashley removed increasing quantities of the brains of rats which had been taught to run in a maze. He found that, provided he did not remove the visual coretex and thus blind them, he could remove up to ninety per cent of their cortex without significant deterioration in their power to thread their way through the maze. There is no man-made machine of which this is true. Try removing nine-tenths of your radio to see if it still brings in a signal! It would seem that each specific memory is distributed in some way over the brain as a whole.
>
> Similarly, you can remove considerable amounts of the motor cortex without paralysing any one group of the muscles. All that happens is a general deterioration of motor performance ... It is better to run clumsily than not at all.
> But how this remarkable distribution of function is achieved we do not really understand. We see, at all events, that the brain relies on patterns of increasing refinement and not (as

FIGURE 2.

## NEW PRODUCT SIGN-OFF




Source: T. Peters and R. Waterman, In Search of Excellence, "New York: Harper & Row, 1982.

man-made machines do) on chains of cause and effect.
(G. R. Taylor, "The Natural History of Mind," 1979:49)

Thus it appears that the brain, with its incredible complexity, manages that complexity by placing the whole into each of its parts -- it is a hologram. Organizations are not designed with this logic, but if possible ought to be.

The hologram metaphor emphasizes that organization design for innovation is not a discrete event but a process for integrating all the relevant functions, organizational units, and resources needed to manage an innovation from beginning to end. It requires a significant departure from traditional approaches to organizing innovation.

Traditionally the innovation process has been viewed as a sequence of separable stages (e.g., design, production, and marketing) linked by relatively minor transitions to make adjustments between stages. There are two basic variations of this design for product innovation. First, there is the technology-driven model where new ideas are developed in the R&D department, sent to engineering and manufacturing to produce the innovation, and then on to marketing for sales and distribution to customers. The second, and currently more popular design is the customer or need-driven model, where marketing comes up with new ideas as a result of close interactions with customers; which in turn are sent to R&D for prototype development and then to engineering and manufacturing for production. Galbraith (1982) points out that the question of whether innovations are stimulated by technology or customer need is debatable.

> "But this argument misses the point." As reproduced in Figure 3, "the debate is over whether [technology] or [need] drives the downstream efforts. This thinking is linear and sequential. Instead, the model suggested here is shown in Figure [3b]. That is, for innovation to occur, knowledge of all key components is simultaneously coupled. And the best way to maximize communication among the components is to have the communication occur intrapersonally -- that is, within one

person's mind. If this is impossible, then as few people as possible should have to communicate or interact. (Galbraith, 1982: 16-17).

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Insert Figure 3 about here

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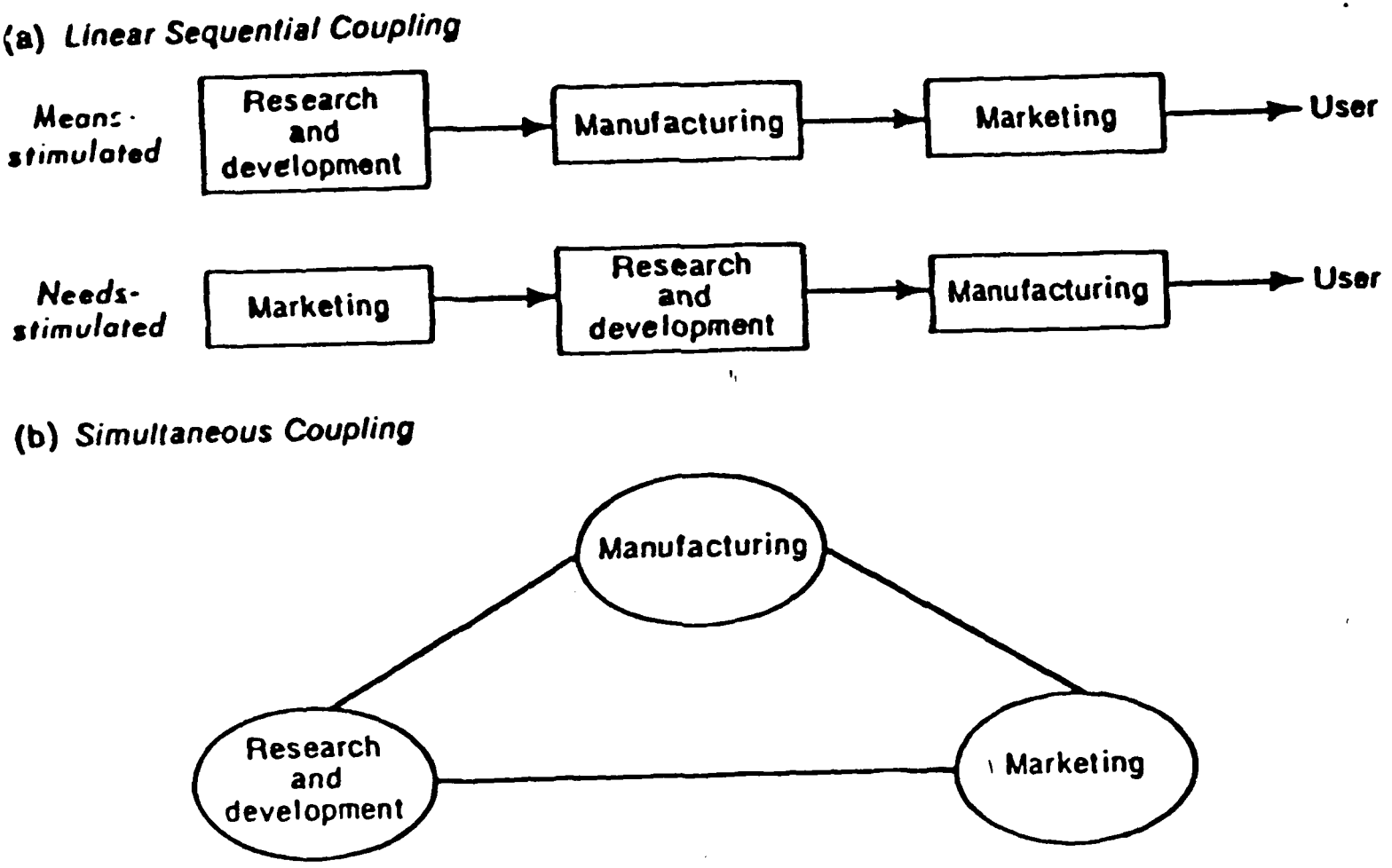
As Galbraith implies, with the hologram metaphor the innovation process is viewed as consisting of iterations of inseparable and simultaneously-coupled stages (or functions) linked by a major ongoing transition process. Whereas the mechanical metaphor of an assembly line of stages characterizes most current views of the innovation process, the biological metaphor of a hologram challenges scholars and practitioners to find ways to place the whole into each of the parts.

Although very little is known about how to design holographic organizations, Gareth Morgan (1983a; 1984) offers several fruitful suggestions. First, flexibility and a capacity for self-organizing is needed by creating redundant functions, which means that people develop knowledge and skills not normally used to perform assigned tasks. Second, a hologram directs attention to structural connectivity instead of differentiation because innovation and learning are facilitated with organizational designs that couple knowledge of all essential specialties in each autonomous group. By definition, autonomous groups are self-organizing, which implies that management follows the principle of "minimum critical specification" in outlining missions and contraints for the group. Third, following Ashby's (1956) principle of requisite variety, learning is enhanced when a similar degree of complexity in the environment is built into organizational components. This holographic strategy places critical dimensions of the whole environment into organizational components and permits these components to develop

FIGURE 3. LINEAR SEQUENTIAL COUPLING COMPARED WITH SIMULTANEOUS COUPLING OF KNOWLEDGE




Source: Jay R. Galbraith, "Designing the Innovating Organization," Organizational Dynamics, Winter, 1982.

and store rich patterns of information and uncertainty for detecting and correcting errors existing in the environment.

Finally, the problem of part-whole relationships must also deal with linking temporal parts (past, present, and future events) into an overall chronology of the innovation process. While most view innovation as making additions to existing arrangements, Stuart Albert (1984c) proposes another arithmetic for linking the past, present and future. Given a world of scarcity, Albert (1984a; 1984b) notes that the implementation of innovations often results in eliminations, replacements, or transformations of existing arrangements. As a consequence, the management of innovation is also the management of termination, and of transitioning people, programs, and investments from commitments in the past and toward the future. In common social life, funerals and wakes are used to commemorate and berieve the passing of loved ones and to make graceful transitions into the future. Perhaps, as Albert suggests, there is a need to create funerals, celebrations, and transitional rituals that commemorate the ideas, programs, and commitments falling out of currency in order to create opportunities for ushering in those that must gain good currency for an innovation to succeed.

## The Context of Innovation and Institutional Leadership

Context is the setting or institutional order in which innovative ideas are developed and transacted among people. Innovation is not the enterprise of a single entrepreneur. Instead, it is a network-building effort that centers on the creation, adoption, and sustained implementation of a set of ideas among people who, through transactions, become sufficiently committed to these ideas to transform them into "good currency" (as discussed above).

Prop. 5 Following holographic principles, this network-building activity must occur both within the organization and in the larger community of which it is a part. Creating these intra- and extra-organizational infrastructures in which innovation can flourish takes us directly to the strategic problem of innovation, which is institutional leadership.

The extra-organizational context includes the broad cultural and resource endowments that society provides, including laws, government regulations, distributions of knowledge and resources, and the structure of the industry in which the innovation is located. Research by Ruttan and Hayami (1983) and Trist (1981) clearly shows that innovation does not exist in a vacuum and that institutional innovation is in great measure a reflection of the amount of support an organization can draw from its larger community. Collective action among institutional leaders within a community becomes critical in the long run to create the social, economic, and political infrastructure a community needs in order to sustain its members (Astley and Van de Ven, 1983). In addition, as Aldrich (1979) and Erickson and Maitland (1982) argue, a broad population or industry purview is needed to understand the societal demographic characteristics that facilitate and inhibit innovation.

Within the organization, context traditionally refers to the strategy, structure, and systems in which innovation may occur. However, a more dynamic aspect of context is the role of institutional leadership in creating a culture or climate that fosters innovation. As Hackman (1984: 40) points out, "an unsupportive organizational context can

easily undermine the positive features of even a well-designed team." There is a growing recognition that innovation requires a special kind of supportive leadership.

> This type of leadership offers a vision of what could be and gives a sense of purpose and meaning to those who would share that vision. It builds commitment, enthusiasm, and excitment. It creates a hope in the future and a belief that the world is knowable, understandable, and manageable. The collective energy that transforming leadership generates, empowers those who participate in the process. There is hope, there is optimism, there is energy (Roberts, 1984: 3).

Institutional leadership goes to the essence of the process of institutionalization. It is often thought that an organization loses something (becomes rigid, inflexible, and loses it ability to be innovative) when institutionalization sets in. This may be true if an organization is viewed as a mechanistic, efficiency-driven tool. But, as Selznick (1957) argued, an organization does not become an "institution" until it becomes infused with value; i.e., prized not as a tool alone, but as a source of direct personal gratification, and as a vehicle for group integrity. By plan or default, this infusion of norms and values into an organization takes place over time, and produces a distinct identity, outlook, habits, and commitments for its participants -- coloring as it does all aspects of organizational life, and giving it a social integration that goes far beyond the formal command structure and instrumental functions of the organization.

Institutional leadership is particularly needed for organizational innovation, which represent key periods of development and transition when the organization is open to or forced to consider alternative ways of doing things.

> Leadership is more dispensible when the range of alternatives is limited by rigid technical criteria. The more limited and defined the task, the more readily can technical criteria prevail in decision making.... But when the organization is

> not so limited, when it has the leeway to respond in alternative ways, there is room for character formation, which enters to give structure to precisely this area of freedom. Hence, leadership, character, and critical decision-making are linked as aspects of the same basic phenomenon: the institutionalization of organizational life (Selznick, 1957: 41).

Selznick emphasized that the central and distinctive responsibility of institutional leadership is the creation of the organization's character or culture. This responsibility is carried out through four key functions: defining the institution's mission, embodying purpose into the organization's structure and systems, defending the institution's integrity, and ordering internal conflict. Selznick (1957:62) reports that when institutional leaders default in performing these functions, the organization may drift. A set of beliefs, values and guiding principles may emerge in the organization that are counterproductive to the organization's mission or distinctive competence. As institutionalization progresses the enterprise takes on a special character, and this means that it becomes peculiarly competent (or incompetent) to do a particular kind of work" (Selznick, 1957: 139). Organization drift is accompanied by loss of the institution's integrity, opportunism, and ultimately, loss of distinctive competence.

Lodahl and Mitchell (1980: 203-204) insightfully apply Selznick's perspective by distinguishing how institutional and technical processes come into play to transform innovative ideas into a set of guiding ideals -- see Figure 4. First there are the founding ideals for an innovation or an enterprise, followed by the recruitment and socialization of members to serve those ideas. Leadership and formalization guide and stabilize the enterprise. When viewed as a set of technical or instrumental tasks, the process is operationalized into setting clear goals or ends to be achieved; establishing impersonal and universal criteria for recruitment,

developing clear rules and procedures for learning and socialization; analytical problem solving and decision making; and routinizing activities in order to reduce uncertainty. Institutional processes are very different from this well-known technical approach. Insititutional processes focus of the the creation of an ideology to support the founding ideals; the use of personal networks and value-based criteria for recruitment; socialization and learning by sharing rituals and symbols; charismatic leadership; and the infusion of values as paramount to structure and formalize activities.

---

Insert Figure 4 about here

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Lodahl and Mitchell (1980: 204) point out that an innovation is an institutional success to the degree that it exhibits authenticity, functionality, and flexibility over time. Authenticity requires that the innovation embodies the organization's ideas; functionality requires that the innovation work; and flexibility requires that the innovation can incorporate the inputs and suggestions of its members. If these tests are met, organizational members will make a commitment to the innovation. In contrast, if institutional skills are not used while technical skills are in operation, the innovation may be an organizational success but an institutional failure. In that case, there will be evidence of drift and disillusionment. Such a result will be characterized by individual self-interest, differentiation, and technical efficiency.

These distinctions between institutional and technical processes have three significant implications for organizational learning, as Morgan (1983b; 1984) draws out with cybernetic principles and the hologram metaphor. Whereas technical processes permit single-loop learning,

FIGURE 1. **INSTITUTIONAL AND TECHNICAL PROCESSES**


| INSTITUTIONAL PROCESSES | | TECHNICAL PROCESSES |
|---|---|---|
| CREATION, ELABORATION OF IDEOLOGY | FOUNDING IDEALS | STATEMENT OF ORGANIZATIONAL GOALS |
| USE OF PERSONAL NETWORKS; SELECTION BASED ON VALUES AND IDEALS | RECRUITMENT | BROAD SEARCH: USE OF UNIVERSALISTIC CRITERIA |
| FACE-TO-FACE CONTACT WITH FOUNDERS: SHARING RITUALS, SYMBOLS | SOCIALIZATION | RULES AND PROCEDURES LEARNED THROUGH COLLEAGUES |
| CHARISMATIC, MYTHIC IMAGES (TRANSFORMING) | LEADERSHIP | PROBLEM SOLVING AND CONSENSUS MAKING (TRANSACTIONAL) |
| IDEALS PARAMOUNT: STRUCTURE TENTATIVE | FORMALIZATION | EARLY ROUTINIZATION; UNCERTAINTY REDUCTION |

SOURCE: T. Lodahl and S. Mitchell, "Drift in the Development of Innovative Organizations," 1980.

institutional processes are paramount for double-loop learning -- i.e., for organizations to learn how to learn.

First, organizations can develop a capacity to control and regulate their own behavior through a process of negative feedback, whereby deviations in one direction initiate action in the opposite direction at every step in performing an activity so that in the end no error remains. Thus, a goal is achieved by avoiding not achieving the goal. In order for learning through negative feedback to occur, an organization must have values and standards which define the critical limits within which system operations are to be maintained. Whereas technical processes focus on creating clear-cut goals and targets to be achieved, institutional processes focus on defining constraints in terms of values and limits. Institutional leadership thus involves a choice of limits (issues to avoid) rather than a choice of ends. As Burgelman (1984:1349) points out, "top management's critical contribution consists in strategic recognition rather than planning." As a result, a space of possible actions is defined which leaves room for technical action plans to be developed and tested against these constraints.

Second, whereas single loop learning involves an ability to detect and correct deviations from a set of values and norms, double loop learning occurs when the organization also learns how to detect and correct errors in the operating norms themselves. This permits an institution to adjust and change its course of action. The principal barriers to this double-loop learning are the technical processes of fragmented divisions of labor, bureaucratic control and accountability systems, and defensive socialization routines (Morgan, 1984). Institutional leadership emphasizes that legitimate error stems from the uncertainity inherent in the nature of a situation.

The major problem in dealing with uncertainty is maintaining a balance on organizational diversity and order over time (Burgelman, 1984). Diversity results primarily from autonomous initiatives of technical units. Order results from imposing standards and a concept of strategy on the organization. Managing this diversity requires framing issues and problems so that they can be approached through experimentation and selection. The process of double-loop learning is facilitated by probing into various dimensions of a situation, and of promoting constructive conflict and debate between advocates of competing perspectives. Competing action strategies lead to reconsideration of the organization's mission, and perhaps a reformulation of that mission.

Finally, although technical processes of formalization press to reduce uncertainty, institutional processes attempt to preserve it. Just as necessity is the motherhood of invention, preserving the uncertainty, diversity, or turbulence in an institution's environment are the major sources of creativity and long run viability for an organization. Embracing uncertainty is achieved through the holographic principles of requisite variety, minimum critical specification, and redundancy of functions discussed in the section on part-whole relations. Application of these principles results in mirroring the turbulence present in the whole environment into the decision processes and other activities of each of the organization's parts. As a consequence, innovative problem solving is enhanced because organizational units are presented with the whole "law of the situation."

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experimentation-and-selection approach is needed so that the organization develops a capacity for double loop learning; i.e., learning how to detect and correct errors in the operating standards themselves. Third, innovation requires preserving (not reducing) the uncertainty and diversity in the environment within the organization because necessity is the motherhood of invention. Embracing uncertainty can be achieved through the principles of requisite variety, minimum critical specification, and redundancy of functions.

In conclusion, it should be recognized that this has been a speculative essay on key problems in the management of innovation. Presently, little empirical evidence is available to substantiate these problems, their implications, and proposed solutions. However, in the near future empirical evidence will be available since my colleagues and I at the University of Minnesota are currently launching a major research program on the management of innovation.

people become connected to ideas over time through a social-political process of pushing and riding their ideas into good currency.

Third, there is the structural problem of managing part-whole relationships, which emerges from the proliferation of ideas, people and transactions as an innovation develops over time. A common characteristic in the development of innovations is that multiple functions, resources, and disciplines are necessary to transform an innovative idea into a concrete reality -- so much so that individuals involved in specific transactions lose sight of the whole innovation effort. If left to themselves, they will design impeccable micro-structures for designing the innovation process that often results in macro nonsense. The hologram metaphor was proposed for designing the innovation process in such a way that more of the whole is structured into each of the proliferating parts? In particular, four holographic principles were proposed for managing part-whole relationships : requisite variety, minimum critical specification, self-organizing teams, and redundancy of functions.

Finally, the context of an innovation points to the strategic problem of institutional leadership. Innovations must not only adapt to existing organizational and industrial arrangments, but they also transform the structure and practices of these environments. The strategic problem for institutional leaders is one of creating an infrastructure that is conducive to innovation and organizational learning. Three cybernetic principles were proposed to develop this infrastructure. First, the principle of negative feedback suggests that a clear set of values and standards are needed which define the critical limits within which system operations are to be maintained. Second, an

## Concluding Summary

Innovation has been defined as the development and implementation of new ideas by people who engage in transactions with others over time within an institutional context. This definition is sufficiently general to apply to a wide variety of technical, product, process, and administrative kinds of innovations. From a managerial viewpoint, to understand the process of innovation is to understand the factors that facilitate and inhibit the development of innovation events over time. As our definition of innovation suggests, these factors include ideas, people, transactions, and context over time. Associated with each of these factors are basic problems or challenges that need to be addressed in a practical theory on the management of innovation.

First, there is the human problem of managing attention. A practical theory of innovation should begin with an appreciation of the physiological limitations of human beings to pay attention to nonroutine issues, and their corresponding enertial forces in organizational life. It was argued that direct personal confrontations with sources of problems, opportunities, and threats are needed to trigger peoples' action thresholds to pay attention and recognize the need for innovation. The more specialized, insulated, and stable an individual's job, the less likely the individual will recognize a need for change or pay attention to innovative ideas.

An inventive or creative idea does not become an innovation until it is implemented or institutionalized. Thus, the second problem in the management of innovation is to understand the process in which new ideas gain good currency and become implemented realities. Donald Schon's (1971) description of the emergence of public policies appears particularly helpful for addressing this problem. He emphasizes that

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